Enhanced Properties and Behavior of Engineered Kaolin in Ceramic Processing

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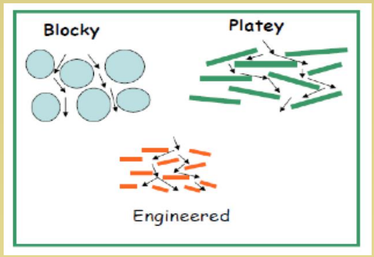
Objective: To investigate the properties of kaolin that influence its processing characteristics specifically in ceramic casting.
Industrial Relevance: The demand and application of engineered kaolin has developed quickly over the past a few decades. Kaolin from different sources exhibits different rheological behaviors, which results in several processing challenges including low casting rate, low body plasticity, poor drain, soft cast.
Broad Appeal: The correlations between particle characteristics and rheological behavior would provide the guidelines to optimize the processing conditions.

Factors and Hypothesis

Factors that Influence Casting Rate:

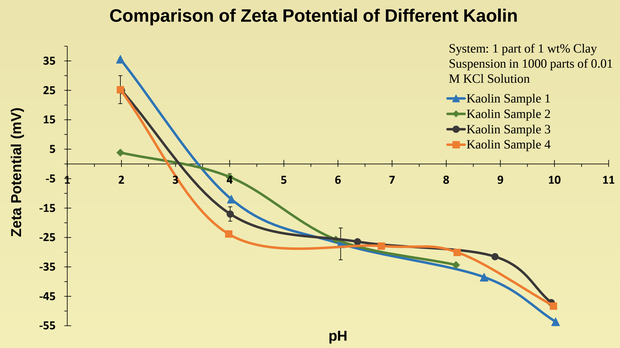
- Particle Size and Distribution
- Particle Shape
- Surface Charge
- Interaction with Deflocculant



Hypothesis:

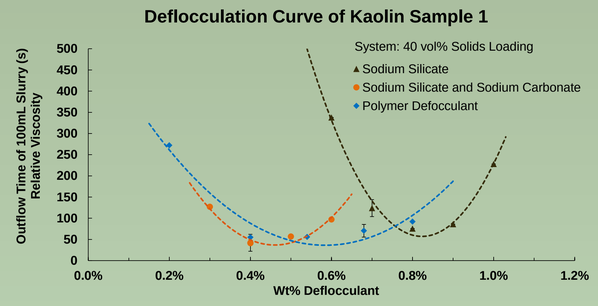
- Plate-like particles, as compare to blocky particles, could be less **fluid** with lower casting rate and exhibit a higher **modulus of rupture** (MoR)—possibly due to the immobilization of the fluid between the particles.

Surface Charge Characteristics

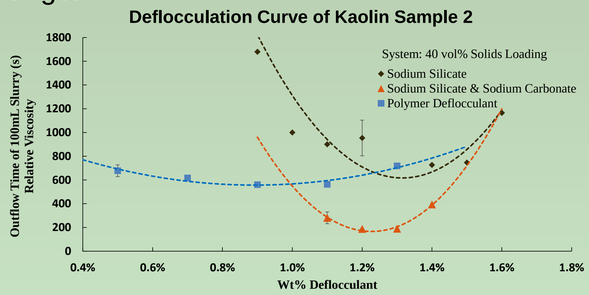


- Comparing with other kaolin samples, the higher IEP value of kaolin #1 suggests that the charge of alumina edge is more dominant than that of the silica face.
- It reflects a complex system of anisotropic particles with heterogeneous nature of the charge distribution.

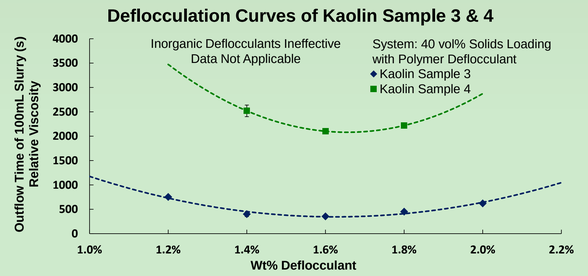
Interaction with Deflocculants



- The introduction of sodium carbonate hinders the edge-to-face attraction of kaolin particles through cationic exchange.

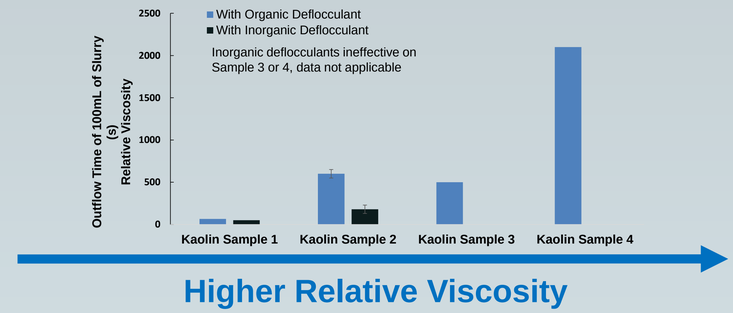


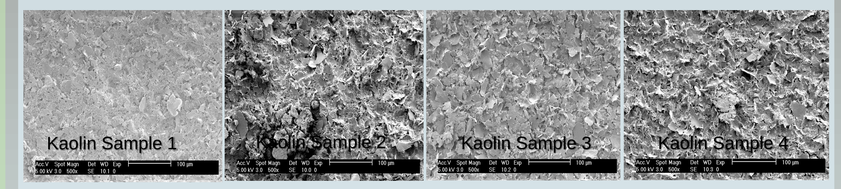
- Soluble impurity salts of Sample 2 could possibly impede the electrolytic action of inorganic deflocculants.



- The functional groups of polymer deflocculant act as spacers, instead of introducing repulsive charges.

Correlations





Higher Particle Aspect Ratio, Lower Casting Rate

Deliverables

- Elucidation of the reasons that cause the variation in casting rate of different kaolin
- Correlations between particle characteristics and rheology of kaolin slurry
- Recommendations for improving the casting rate of both original and engineered kaolin
- Recommendations for dispersants' type, dosages, ratios, etc. that produce slips of required casting behavior

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